Document name	**TPL-001-WECC-CRT-2 — System Performance Criterion**
Category	( ) Regional Reliability Standard (X) Regional Criteria ( ) Policy ( ) Guideline ( ) Report or other ( ) Charter
Document date	
Adopted/approved by	
Date adopted/approved	
Custodian (entity responsible for maintenance and upkeep)	
Stored/filed	Physical location: Web URL:
Previous name/number	(if any)
Status	( ) in effect ( ) usable, minor formatting/editing required ( ) modification needed ( ) superseded by _____ ( ) other _____ ( ) obsolete/archived

WECC Criteria Development Roadmap

This section is maintained by the drafting team during the development of the criteria.

Development Steps Completed:

Completed Actions	Completion Date
1. Request received	February 5, 2010
2. Requested deemed Complete/Valid/Team Site created	February 8, 2010
3. Standards Request Routing Committee (SRRC) notified	February 8, 2010
4. Standard Request Comments Due	February 22, 2010
5. SRRC assigned the Request to Standing Committee	March 12, 2010
6. Notice of Development / First 30-day Notice	March 12, 2010
7. Drafting Team Announced / Notice sent to Drafting Team members	April 14, 2010
8. New Chair Orientation meeting	April 14, 2010
9. First Drafting Team meeting (sequence may vary for items #6-9 depending on SRRCs Drafting Team assignment choice)	April 14, 2010
10. Complete the first draft / Complete Quality Control Checklist	March 21, 2011
11. Post the first draft for 45-day comment	March 23, 2011
12. First draft comments due to WECC	May 9, 2011
13. Meet to answer to comments, address impact statement, draft responses	May 12, 2011 May 19, 2011 May 26, 2011
14. Post Responses to 45-day comment on to WECC's website	June 10, 2011
15. Meet to answer to revise criterion	June 27, 2011 August 2, 2011
16. Post the second draft for 30-day comment / Complete Quality Control Checklist	August 6, 2011
17. Version 2 Comments were due	September 6, 2011
18. Meet to answer to comments, address impact statement, draft responses	September 7, 2011
19. Vote to forward final draft to the Standing Committee	September 7, 2011
20. Post Responses to 30-day comment on to WECC's website	September 9, 2011
21. Final draft with Implementation Plan / Complete Quality Control Checklist	September 9, 2011

22. Chair completes Transmittal Letter	September 9, 2011
23. Post for Planning Committee Approval	September 9, 2011

Future Criteria Development:

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Anticipated Actions	Anticipated Date
1. Standing Committee meets to vote	October 12, 2011
2. If approved post for Board of Director Ballot	October 25, 2011
3. Board of Director Ballot	November 30, 2011
4. Proposed effective date	April 1, 2012
5. WECC SRRC Support transfer document back to Standards	April 1, 2012
6. Team Site archived	April 15, 2012

Procedural Description of Current Draft

In accordance with the *Process for Developing and Approving WECC Standards*, Project WECC-0071 — System Performance Criterion has been posted for a 30-day comment period as well as for approval at the October 2011 Planning Coordination Committee meeting in Hollywood, CA. The comment period closes at midnight (Mountain time) on October 10, 2011.

Background

Refinements to WECC's Existing TPL-001 through 004-WECC-1-CR – System Performance Criteria could allow for increased use of transmission corridors, improve the siting and permitting process for transmission expansion, and ensure that the current reliability levels of the Western Interconnection are not compromised.

The current TPL-(001 thru 004)-WECC-1-CR — System Performance Criteria places a higher system performance requirement on adjacent circuits in a common corridor than on two separate circuits not in a common corridor. In some cases, the higher system performance requirements limit existing path ratings that have two circuits in a defined common corridor, in addition to limiting new or planned corridors. These requirements create significant hardship for environmental siting/permitting due to the following reasons:

1. For two circuits within WECC's definition of a Common Corridor, the project developers must apply the restrictive performance requirements of WRS1 and WRS1.1 of TPL-(001 thru 004)-WECC-1-CR, which may limit the rating

capacities for energy transfer amounts. This may hinder the development of renewable energy resources.

2. Project developers for many projects, which currently are in the siting and permitting stage of development, are finding that they cannot place an additional line in an existing transmission corridor due to the more stringent system performance requirements placed on facilities in order to comply with the existing WECC Criteria. However, it is difficult to convince federal and state land management agencies that independent corridors are needed to achieve maximum transfer capability for the projects.
3. Higher system performance requirements:
    a. Limit the use of the transmission lines in a common corridor.
    b. Do not recognize benefits of structure types and termination locations.
    c. Do not give benefit to putting transmission circuits on separate towers rather than multiple circuit towers.
    d. Do not distinguish between adjacent lines that are short with less exposure and those that run over long distances.

Scope:

The current Project WECC-0071 criterion request specifically limits refinements to the existing TPL-(001 thru 004)-WECC-1-CR Criteria to the definitions, and to WRS1 and WRS1.1. Changes to Table W-1 and other requirements have not been addressed at this time.

Proposed Refinements

The availability of actual and accurate system performance data is limited to the last three years of WECC Transmission Reliability Database (TRD) data. These limited statistics showed that the probability of a double-circuit tower line outage (NERC Category C-5) was roughly two times more likely than the outage of two circuits on separate, yet adjacent structures. The Project WECC-0071 Drafting Team (Drafting Team) decided that, although this limited data set was not conclusive, it did demonstrate that double-circuit outages of circuits on common structures had higher probability than double-circuit outages on separate structures in the same right-of-way. While the outage data demonstrates that the outage behavior of two circuits on the same structure (e.g., 0.231 vs. 0.111 average outages per 100 miles of transmission lines per year with the same event ID) is somewhat higher than that of two circuits on separate structures on the same right-of-way, it is not an order of magnitude higher as some would have expected (see Tables 1 and 2). As a result the Drafting Team concluded that the criterion should not be eliminated.

The TRD data in Tables 1 and 2 suggest that double-circuit outages per 100 miles of line for adjacent circuits (two circuits on the same right-of-way separate structures) are not significantly different than the number of double-circuit outages per 100 miles of line where the circuits are on separate structures not on the same right-of-way (e.g., 0.111

vs. 0.145 average outages per 100 miles of transmission lines per year with the same event ID). Because of the limited TRD data, the Drafting Team was not ready to conclude there is no need for a more restrictive criterion, but it believes that the TRD data should be reviewed as new data are available.

The Drafting Team believes that there is still a need for an adjacent circuit criterion. The refinements in the proposed criterion effectively make changes to the definitions and applicability of the criterion, aligning it with what the Drafting Team believes is the original intent of the criterion: to maintain reliability of the Western Interconnection.

Throughout the Drafting Team's development of the criterion, it had become apparent that many entities were not familiar with WECC's Reliability Performance Evaluation Workgroup's (RPEWG) Performance Category Upgrade Request process. This process would remain intact and could still be used for actual situations where the transmission project meets the requirements set by the RPEWG to obtain a Performance-Level Adjustment.

The Drafting Team is recommending that the definition for Common Corridor be removed from the criterion and retired as a definition. The reasons for the removal and retirement are:

1. The only place the term Common Corridor is used is in the definition for Adjacent Transmission Circuits. With the proposed refinements to the Adjacent Transmission Circuits definition, the term Common Corridor is no longer in use in the TPL criterion or in the NERC Reliability Standards. Therefore, a definition for Common Corridor is no longer needed.
2. Several regulatory agencies have definitions for Common Corridor that conflict with WECC's definition. For example, the Bureau of Land Management's corridor definition is more variable than WECC's definition, which allows the following:
    a. Width on the order of thousands of feet,
    b. Multi-modal [Multi-use, right-of-way corridor], and
    c. Prescribed boundaries, but some variability in interpretation.
3. The WECC definition is creating confusion in the industry when entities are discussing corridor issues with regulators.
4. The definition for Adjacent Transmission Circuits is being modified to incorporate separation language.

The Drafting Team is proposing to refine the definition for Adjacent Transmission Circuits to incorporate separation language that was contained previously in the Common Corridor definition. It should be noted that the Drafting Team modified the distance between the structure center line separation from "less than the longest span length of the two transmission circuits at the point of separation or 500 feet" to "separation between their center lines less than or equal to 250 feet at the point of separation." The 250 feet distance was selected because it is approximately the maximum height of a 500 kV tower with some margin. The Drafting Team decided that the reduced separation distance is appropriate for the following reasons:

1. The original reason for the span length requirement in the criterion is the possibility of an airplane dragging a conductor from one circuit to another circuit on a separate tower. The Drafting Team believes that this is an extremely low-probability event and practically impossible. Designing the system for this very low-probability event by treating the two circuits as if they are on the same tower is not appropriate.
2. Current transmission structures are designed to crumple, not topple, so circuits on separate towers with center lines of at least the maximum tower height (e.g., 250 feet) are very unlikely to fall into each other. As a result, the Drafting Team decided that performing studies equivalent to a double-circuit structure was not warranted.
3. The three main causes of outages on adjacent circuits on separate towers, according to the 2008-2010 TRD data, are: weather (other than lightning), lightning, and fire.
    a. The primary reason for the previous distance was to mitigate outages caused by fire. The time between common outages as a result of fire varies, depending upon the rate the fire advances. Often Transmission Operators have time to reduce transfers, even though the fire is moving at a rapid rate, because they are notified of the fire in the area. The time delay between outages caused by fire, and the advance preparation that is likely for fires, reduces the severity of the multiple circuit outages when there are separate towers. The Drafting Team believes that requiring increased performance equivalent to a double-circuit outage on a common tower for this condition is not warranted.
    b. The number of common outages on Adjacent Transmission Circuits with separate towers due to weather and lightning is expected to remain about the same, even with the reduction in distance between structure centerlines in the Adjacent Transmission Circuit definition, because most existing Adjacent Transmission Circuits are within 250 feet of each other.
4. Rather than use a variable tower height in the Adjacent Transmission Circuits definition in the criterion, the Drafting Team believes that a constant distance is preferred for clarity and ease of implementation. Using a maximum tower height as the prescribed distance between adjacent circuits provides some additional buffer against multiple outages.
5. The 2008-2010 TRD data suggests that transmission circuits on common right-of-way and non-Adjacent Transmission Circuits have about the same outage rates per 100 miles of line (see Tables 1 and 2). As a result of that analysis, the Drafting Team believes that there will not be any significant change in reliability by reducing the distance between transmission lines before being considered as Adjacent Transmission Circuits.

The Drafting Team made the following refinements in the applicability section of the criterion:

1. In Section 4.2.1, it changed the applicability of Part 1.1 of Requirement R1 to only those cases when both Adjacent Transmission Circuits are greater than or equal to 300 kV. The intent of WECC's criterion is to limit impacts to other systems, and the Drafting Team feels that lower-voltage line outages will be unlikely to impact other systems.

2. Chose three miles to cover the station entrances, plus short distances in the middle of the line for geographic restrictions. The present criterion excludes lines that are adjacent for five spans or less at station entrances. (The five spans at station entrances are approximately one mile for typical EHV line construction.) The Drafting Team decided that the criterion also should not apply for short distances, specifically for geographic restrictions such as river and/or canyon crossings.
3. Restored the provision that excluded transmission circuits from being considered as Adjacent Transmission Circuits when there is a Bulk Electric System circuit between them in response to comments.
4. Retained the concept that Requirement R1 should only apply on facilities external to a Transmission Planner area.
5. Replaced non-three-phase fault with single-line-to-ground fault in Part 1.1 of Requirement R1. It also added a clarifying sentence at the end of Part 1.1 of Requirement R1 that the requirement only applies to simultaneous outage of two transmission circuits.

Common Cause Outage Events
Table 1
June 1, 2011

		Circuits on Common Structure	Circuits on Common Right-of-Way Separate Structures	Circuits not on Common Right-of-Way or Structure
2010	Transmission miles	9,219	14,954	52,734
	Number of Events	31	23	126
	No. of Outages/ 100 miles of line	0.336	0.154	0.239
2009	Transmission miles	8,386	15,530	50,709
	Number of Events	20	14	79
	No. of Outages/ 100 miles of line	0.238	0.090	0.156
2008	Transmission miles	8,386	15,530	47,975
	Number of Events	33	25	87
	No. of Outages/ 100 miles of line	0.394	0.161	0.181
Average	Transmission miles	8,664	15,338	50,473
	Number of Events	28	20.67	97.33
	No. of Outages/ 100 miles of line	0.323	0.135	0.193

Common Cause Events
Includes momentary outages.
Includes outages that are within 10 minutes of start time that became at least an n-2.
Does not include events with a transformer and circuit but does include events with transformer and two-circuit outages.

Same Event ID Number
Table 2
June 1, 2011

		Circuits on Common Structure	Circuits on Common Right-of-Way Separate Structures	Circuits not on Common Right-of-Way or Structure
2010	Transmission miles	9,219	14,954	52,734
	Number of Events	15	17	90
	No. of Outages/ 100 miles of line	0.163	0.114	0.171
2009	Transmission miles	8,386	15,530	50,709
	Number of Events	18	13	60
	No. of Outages/ 100 miles of line	0.215	0.084	0.118
2008	Transmission miles	8,386	15,530	47,975
	Number of Events	27	21	70
	No. of Outages/ 100 miles of line	0.322	0.135	0.146
Average	Transmission miles	8,664	15,338	50,473
	Number of Events	20	17	73.33
	No. of Outages/ 100 miles of line	0.231	0.111	0.145

Common Event ID
Includes momentary outages.
Does not include events with a transformer and circuit but does include events with transformer and two-circuit outages.

Implementation Plan

The refinements in this criterion are to become effective on the first day of the first quarter, at least 45 days after approval by WECC's Board of Directors (Board).

Version Control

Version	Date	Action	Change Highlights
1	March 18, 2011	Version 1 Posted	Revised Definitions
2		(Insert completion steps as needed)	
3		Standing Committee Approval	
4		WECC Board Approval	

Definitions

Adjacent Transmission Circuits:

Adjacent Transmission Circuits are two transmission circuits with separation between their center lines less than 250 feet at the point of separation with no Bulk Electric System circuit between them. Transmission circuits that cross, but are otherwise separated by 250 feet or more between their centerlines, are not Adjacent Transmission Circuits.

A. Introduction

1. **Title: System Performance Criterion Under Normal Conditions, Following Loss of a Single BES Element, and Following Extreme BES Events**

2. **Numbers: TPL-001-WECC-CRT-2**

3. **Purpose:** System simulations and associated assessments are needed periodically to ensure that reliable systems are developed that meet specified performance requirements with sufficient lead time, and that systems continue to be modified or upgraded as necessary to meet present and future system needs.

4. **Applicability**

   4.1. Functional Entities

   4.1.1 Planning Coordinator

   4.1.2 Transmission Planner

   4.2. Facilities

   4.2.1 Part 1.1 applies to only Adjacent Transmission Circuits where both circuits are greater than or equal to 300 kV.

   4.2.2 Requirement R1 only applies to effects on facilities external to a Transmission Planner area.

   4.2.3 Part 1.1 of Requirement R1 does not apply to Adjacent Transmission Circuits that share a common right-of-way for a total of three miles or less, including – but not limited to – substation entrances, pinch points, and river crossings.

5. **Effective Date:** The first day of the first quarter, at least 45 days after approval by WECC's Board of Directors (Board).

B. Requirements

R1. In addition to NERC Table 1[1], each Planning Coordinator and Transmission Planner shall comply with WECC's Disturbance-Performance Table (Table W-1) of Allowable Effects on Other Systems and Part 1.1–1.4, contained in this section, when planning the Transmission System in the Western Interconnection.

1.1. The NERC Category C.5[2] initiating event of a single-line-to-ground fault with normal clearing shall also apply to the common mode contingency of two Adjacent Transmission Circuits on separate towers — unless the Mean Time Between Failure (MTBF)[3] is determined to be greater than 30 years (i.e., outage frequency is less than 0.033 outages per year).

1.2. The common mode simultaneous outage of two generator units connected to the same switchyard, not addressed by the initiating events in NERC Category C, shall not result in cascading.

1.3. The loss of multiple bus sections, as a result of a failure or delayed clearing of a bus tie or bus sectionalizing breaker, shall meet the performance specified for Category D of Table W-1.

1.4. For contingencies involving existing or planned facilities, the Table W-1 performance category can be adjusted based on actual or expected performance (e.g., event outage frequency and consideration of impact) after receiving Board approval to change the Performance Level Adjustment Record.

R2. Individual systems or a group of systems may apply requirements that differ from specific requirements in Table W-1 for internal impacts. If the individual requirements are less stringent, other systems are permitted to have the same impact on that part of the individual system for the same category of disturbance. If these requirements are more stringent, these requirements may not be imposed on other systems. This does not relieve the system or group of systems from WECC requirements for impacts on other systems.

R3. Reactive power resources, with a balance between static and dynamic characteristics, shall be planned and distributed throughout the interconnected transmission systems to ensure system performance as defined below:

3.1. For transfer paths, voltage stability is required with the pre-contingency path flow modeled at a minimum of 105% of the path rating for system normal conditions (Category A) and for single contingencies (Category B).

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[1] NERC TPL-001-0 through TPL-004-0 Planning Standards
[2] NERC Table 1
[3] WECC Seven Step Process for Performance Category Upgrade Request at: http://www.wecc.biz/committees/StandingCommittees/PCC/RS/RPEWG/Shared%20Documents/Seven_Step_Process_BOD_Approved_12-7-04.pdf

For multiple contingencies (Category C), post-transient voltage stability is required with the pre-contingency transfer path flow modeled at a minimum of 102.5% of the path rating.

3.2. For load areas, voltage stability is required for the area modeled at a minimum of 105% of the reference load level for system normal conditions (Category A) and for single contingencies (Category B). For multiple contingencies (Category C), post-transient voltage stability is required with the area modeled at a minimum of 102.5% of the reference load level. For this criterion, the reference load level is the maximum established planned load limit for the area under study.

3.3. Specific requirements that exceed the minimums specified in 3.1 and 3.2 may be established, to be adhered to by others, provided that technical justification has been approved by WECC's Planning Coordination Committee (PCC).

3.4. R3 applies to internal WECC Member Systems as well as between Member Systems.

R4. The Planning Coordinators and Transmission Planners shall meet the same performance category for unsuccessful reclosing, as that required for the initiating disturbance without reclosing.

R5. For any event that has actually resulted in cascading, action must be taken so that future occurrences of the event will not result in cascading; or it must demonstrate that the Mean Time Between Failure (MTBF) is greater than 300 years (frequency less than 0.0033 outages/year) and approved by PCC.

5.1. Any contingency adjusted to Category D must not result in a cascading outage unless the MTBF is greater than 300 years (frequency less than 0.0033 outages/year); or the initiating disturbances and corresponding impacts are confined to either a radial system or a local network.

C. Measures

M1. Planning Coordinator or Transmission Planner has documentation that it complies with WECC's Disturbance-Performance Table (Table W-1) of Allowable Effects on Other Systems as required by R1.

M2. The Planning Coordinator or Transmission Planner has documentation that it has planned for reactive power resource as required by R3.

M3. The Planning Coordinator or Transmission Planner has documentation that it meets the same performance category for unsuccessful reclosing as required by R4.

M4. The Planning Coordinator or Transmission Planner, with less stringent individual requirements than these WECC requirements, has documentation that other Planning Coordinators or Transmission Planners performance are

permitted to have the same impact on that part of the individual system for the same category of disturbance.

M5. The Planning Coordinator or Transmission Planner has documentation that it has Planning Coordination Committee (PCC) approval to adjust in Table W-1 the Performance Level Adjustment Record involving existing or planned facilities.

M6. For any event that has actually resulted in cascading, the Planning Coordinator or Transmission Planner shall have documentation that it has taken action so that future occurrences of the event will not result in cascading, or it must have documentation that it has PCC approval that the Mean Time Between Failure (MTBF) is greater than 300 years (frequency less than 0.0033 outages/year).

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Monitoring Responsibility

Western Electricity Coordinating Council (WECC)

1.2. Compliance Monitoring Period and Reset

Annual

1.3. Data Retention

Four Years

1.4. Additional Compliance Information

None

Version History Shows Approval History and Summary of Field

1	April 6, 2008	Replaces the Part I - NERC/WECC Planning Standards	
2		Refine the Definitions and Applicability Section	

WECC DISTURBANCE-PERFORMANCE TABLE
OF ALLOWABLE EFFECTS ON OTHER SYSTEMS

NERC and WECC Categories	Outage Frequency Associated with the Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard	Post Transient Voltage Deviation Standard (See Note 3)
A	Not Applicable	Nothing in addition to NERC.		
B	≥ 0.33	Not to exceed **25%** at load buses or **30%** at non-load buses. Not to exceed **20% for more than 20 cycles** at load buses.	Not below **59.6** Hz for 6 cycles or more at a load bus.	Not to exceed **5%** at any bus.
C	0.033 – 0.33	Not to exceed **30%** at any bus. Not to exceed **20% for more than 40 cycles** at load buses.	Not below **59.0** Hz for 6 cycles or more at a load bus.	Not to exceed **10%** at any bus.
D	< 0.033	Nothing in addition to NERC.		

Table W-1

Notes:

1. *The WECC Disturbance-Performance Table applies equally to either a system with all elements in service, or a system with one element removed and the system adjusted.*

2. *As an example in applying WECC's Disturbance-Performance Table, a Category B disturbance in one system shall not cause a transient voltage dip in another system that is greater than 20% for more than 20 cycles at load buses, or exceed 25% at load buses or 30% at non-load buses at any time other than during the fault.*

3. *If it can be demonstrated that post-transient voltage deviations that are less than the values in the table will result in voltage instability, the system in which the disturbance originated and the affected system(s) shall cooperate in mutually resolving the problem.*

4. *Refer to Figure W-1 for voltage performance parameters.*

5. *Load buses include generating unit auxiliary loads.*

6. *To reach the frequency categories shown in WECC's Disturbance-Performance Table for Category C disturbances, some planned and controlled islanding may occur. Underfrequency load shedding is expected to arrest this frequency decline and assure continued operation within the resulting islands.*

7. *For simulation test cases, the interconnected transmission system steady-state loading conditions prior to a disturbance shall be appropriate to the case. Disturbances shall be simulated at locations on the system that result in maximum stress on other systems. Relay action, fault clearing time, and reclosing practice shall be represented in simulations according to the planning and operation of the actual or planned systems. When simulating post-transient conditions, actions are limited to automatic devices, and no manual action is to be assumed.*

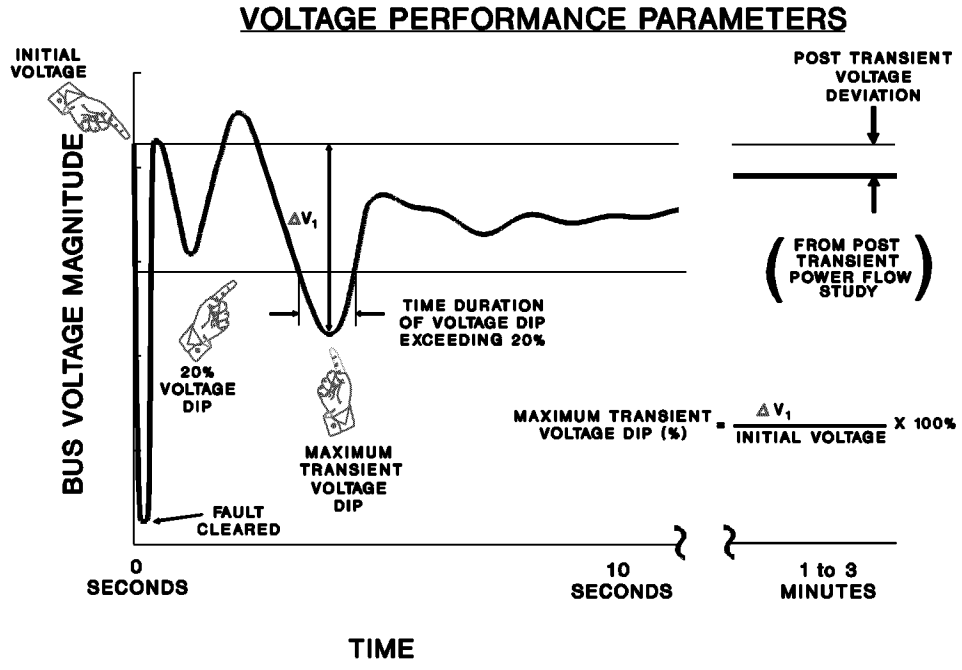

Figure W-1